

## §81. Promotion of All-Japan ST Research Program

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Based on the recommendation of the Fusion Research Working Group and the conclusions of the “Kyushu University Plasma Boundary Dynamics Experimental Device Review Committee”, spherical tokamak (ST) research in Japan was reorganized in 2005 as All-Japan ST Research Program (AJSTRP) supported by NIFS Bi-Directional Collaboration, and a new ST device QUEST was constructed at Kyushu University to fulfill one of the two main missions of this program, steady state operation. The formal establishment of the NIFS Bi-Directional Collaboration Research Promotion Expert Subcommittee for ST Research (ST Subcommittee) in November 2006 marked a great progress. The ST Subcommittee makes plans for activities in the entire field of ST research, coordinates collaborative efforts among different research groups, discusses any issues related to ST research, and reports to NIFS Bi-Directional Collaboration Committee as necessary. Since then, this Subcommittee has been working to establish the research plan of AJSTRP and to coordinate its activities. The activities of the ST Subcommittee are published on the AJSTRP website at NIFS, <http://www.nifs.ac.jp/kenkyo/icr/st.html>.

AJSTRP promotes creative and innovative research at universities and other institutions. Examples include non-inductive plasma start-up and ultra-high beta ST formation by plasma merging. In order to maintain international competitiveness and to make significant contributions internationally, it is crucial to integrate all resources, including experimental research using existing ST devices as well as theoretical and computational research. The purpose of this collaborative research is to plan and promote the activities of AJSTRP, making maximum utilization of the NIFS Bi-Directional Collaboration framework, actively involving various ST research groups.

The Twelfth and the Thirteenth Meetings of the ST Subcommittee were held during FY2012. The Twelfth Meeting was held at Kyushu University on July 31, 2012. The Thirteenth Meeting was held at NIFS on March 5, 2013.

In order to accomplish the goals of AJSTRP, it is crucially important to make collaborations among different ST groups much more active. To alleviate the serious shortage of research budget and manpower, each group should share expertise (such as Thomson scattering from Univ. Tokyo, data acquisition and analysis from NIFS, gyrotron from Univ. Tsukuba) and maximize utilization of limited resources. Research on QUEST is supported by the Kyushu University part of NIFS Bi-Directional

Collaboration, but up to now it has not been easy to support collaborations among other universities (such as between Univ. Tokyo and Kyoto Univ.). A new category called “Network-Type” Collaboration, which allows direct collaboration between “non-Center” universities, started in 2011. This system is being used to enhance the activities of AJSTRP.

The ST Subcommittee has the function of coordinating contributions to the IEA Implementing Agreement (IA) from Japan. The Executive Committee for the IA on ST met on October 9, 2012 during the IAEA Fusion Energy Conference in San Diego. Participants from Japan were A. Komori and Y. Takase (Chair). The IA has completed its first 5-year term, and was extended until June 2017. Under Annex I of this IA (Co-operation on ST Science R&D), experiments on plasma start-up by the electron Bernstein wave are being carried out on MAST using a high-power (200 kW) long-pulse (0.3 s) 28 GHz gyrotron transferred from ORNL. Japan leads the world in this research, and Japanese contribution is very important. The success of these experiments would open up a way to operate tokamak devices without the use of the central solenoid, and would make a huge impact on the design of burning ST devices such as a volumetric neutron source and a commercial fusion reactor. Two new Annexes were initiated under this IA: Annex II (Physics and Technology of Future Spherical Torus Devices) to accelerate progress of research on the physics and technology of future ST devices, and Annex III (Steady State Operation of Fusion Devices) to accelerate progress of research on the physics and technology of steady state operation of fusion devices. An important activity of the IEA IA is to organize the International ST Workshop (ISTW), which is held every other year, on years in which IAEA FEC is not held. The next ISTW will be held in York, UK during the period September 16-18, 2013.

The two largest ST devices in the world, NSTX (PPPL, USA) and MAST (CCFE, UK) are either undertaking or will soon undertake major device upgrades, and steady-state burning plasma facilities to provide fusion neutrons for material and component testing (Fusion Nuclear Science Facility and Component Test Facility) are under discussion. Therefore, international collaborations will become increasingly more important. Frameworks such as the IEA IA and associated Annexes will play important roles in this regard.

Collaborations with the US could be funded under the framework of the Japan-US Cooperation Program, whereas collaborations with MAST could be supported by the NINS Project “Study of turbulence, magnetic islands, and magnetic field lines in magnetically confined plasmas”. In addition, new collaboration activities with China and Korea have started under the A3 Foresight Program “Innovative Tokamak Plasma Startup and Current Drive in Spherical Torus.”